USDA
NATURAL RESOURCES
CONSERVATION SERVICE
MARYLAND
CONSERVATION PRACTICE
STANDARD

FENCE

CODE 382
(Reported in feet)

DEFINITION

A constructed barrier to livestock, wildlife or people.

PURPOSES

1. Exclude livestock or wildlife from areas that are to be protected from grazing or browsing.
2. Confine livestock or wildlife in an area.
3. Control domestic livestock while allowing for some wildlife movement.
4. Subdivide grazing land to permit use of grazing systems.
5. Provide protection of new seedings or plantings.
6. Regulate access to area by people.
7. Provide protection of streams and increase/ protect water quality.

CONDITIONS WHERE PRACTICE APPLIES

Any area requiring control or exclusion of livestock, wildlife or people.

CONSIDERATIONS

The fence system shall be designed to serve the intended use of a visual and physical barrier. Resources, environmental values, and safety shall be considered in the planning process.

Boundary fences shall comply with state laws and standards of construction. Consider soil erosion potential when planning and constructing a fence especially on steep slopes.

WATER QUALITY AND QUANTITY

As a component of livestock grazing for forage management or to exclude livestock and people from streams or other conservation practices, fencing will enhance surface water quality and protect/improve ground water quality.

Other Considerations

1. type and habitat of livestock or wildlife.
2. location and adequacy of watering facilities.
3. topographic features.
4. soil characteristics.
5. landscape resources.
6. equalization of forage production of the grazing units.
7. location of livestock handling/feeding facilities.
8. proposed or potential grazing systems.
9. life expectancy of fence.
10. Federal, State, or local fencing codes.

CRITERIA

General

Fencing materials used shall be of sound quality and durability, and proven effective for the planned purpose.

Type

The purpose for which the fence is to be used will determine the type to be constructed. Sheep and hogs generally need woven wire, horses may need wooden or another non-injurious fence, cattle can be contained with barbed or electric wire, while chain link fence is more desirable to protect people from hazardous conditions.

When considering temporary fencing, the fence must comply with the materials specifications set forth in this standard and at a minimum follow strand specifications established for interior electric fencing.

Alignment

Long, straight runs of fence are more desirable than short, irregular shaped runs. When designing electric fences, it is best to fence in a circuit to allow for maximum charging ability.

Location

If not already established, permanent fences should be located after a soil conservation and water quality plan has been developed. Fences should be located adjacent to vegetative edges or other established lines in the landscape when practical in order to facilitate management requirements.

Erosion Control

Special measures need to be taken concerning erosion when fencing, as livestock paths and trails can develop near fence lines. Avoid fence lines in natural draws or drainage ways. This may protect and prolong the vegetative cover and control erosion.

SPECIFICATIONS

MATERIALS

FENCE FABRIC

Barbed Wire - will consist of not less than four wires and shall be 12 1/2 gauge with a 4-point barb spaced no more than 6 inches apart or 15 1/2 gauge high tensile barbed wire.

Woven Wire - will consist of a 10 gauge top and bottom wire with 12 1/2 gauge wire in between. Wire stay spacing shall not be more than 12 inches apart. When used with cattle, one strand of barbed wire should be placed at the top no more than 2 inches from the woven wire. This prevents cattle from crushing the top with their head and necks.

Wooden Boards - are not widely used because of the expense of labor and materials. However, in some cases, all wood fences are more suited. The boards should be 1 inch thick and at least 6 inches wide. Board lengths of 16 feet are more desirable so as to stagger the unions when placed on posts in 8 foot centers. This staggering provides additional strength to the fence system. Wood surfaces shall be painted or treated with a preservative material for protection against rot. Boards should be flat and fit tight against the post. Nail holes should be predrilled into the boards to prevent splitting.

Polywire - may be used for portable and temporary electric fences. Polywire shall have a minimum of 7 stainless steel strands running through the fabric.

Chain Link - shall be 6 foot high, 9 gauge wire woven into a 2 inch diamond shape in which the individual pickets are helically wound and interwoven to form a continuous link fabric. Hot-dipped galvanized material will be 2 ounces of zinc coating per square foot and should be evenly distributed over the entire fabric as per ASTM A392, Class II.

The following minimum breaking strength shall apply: 1290 pounds and be 9 gauge (0.148"). The fabric shall be twisted, top and bottom. All chain link fence fabric will carry the manufacturer's identification tag.

High Tensile Wire - shall be new, smooth, and meet or exceed the following specifications:

1. 1000 lbs breaking strength.
2. type III galvanized.
3. 14 gauge wire minimum.
4. 150 lbs minimum tension per wire with in-line strainer.

FASTENERS

Nails - for board fence, nails should be galvanized and not less than 3 3/4" long. If using locust posts, nail in a diamond shape whenever possible to keep the wood from splitting. Predrill boards to prevent splitting.

Insulators - can be used to fasten electric fence fabric to a post. Since insulators come in many varieties, specifications are to choose one intended to hold the fence material in an acceptable manner.

Staples - for wooden posts, staples should be of 9 gauge galvanized wire with a minimum of 1 1/4" length. Staples should be driven at an angle to the grain and not tight against the wire (see Attachment 1).

Clips - for steel and notched fiberglass or plastic posts, clips should be hooked over the notch and wrapped around the line wire tightly to secure wire to the post (see Attachment 1).

Splices and Knots (see Attachment 2)

POSTS

A post is a stake of material set upright into the ground to serve as support for fence fabric. Posts shall be established by driving, augering, or hand digging. Fill material shall be clean soil material with little rock and hand tamped in 6 inch lifts. Cement shall be of a Portland mix type and sloped at the top to provide positive drainage.

Wood - shall have all bark removed and be black locust, cedar, or preservative pressure treated (ppt). PPT lumber shall be treated with a minimum retention of 0.40 lbs/cubic foot chromated copper arsenate (cca), type A, B, or C.

1. Untreated corner and gate posts shall have a minimum 6 inch diameter on the small end and be set 4 feet deep below the soil surface.

2. Untreated line and brace posts shall have a minimum 4 inch diameter on the small end and be set 2 1/2 feet deep below the soil surface.

3. Pressure treated corner and gate posts shall have a minimum 5 inch diameter on the small end and be set 4 feet deep below the soil surface.

4. Pressure treated line and brace posts shall have a minimum 3 inch diameter on the small end and be set 2 1/2 feet deep below the soil surface.

Fiberglass - rods shall have a minimum diameter of 0.375", be of adequate length for the fence fabric, have a minimum depth of 6" with deeper sets in dips or low spots in the fence line, and be of smooth finish.

Steel Rods - rods shall have a minimum diameter of 0.359", be of adequate length for the fence fabric, have a minimum depth of 6" with deeper sets in dips or low spots in the fence line, and have an aluminum paint finish.

Steel - posts shall be hot-dipped galvanized with at least 2 ounces of zinc coating per square foot per ASTM 669. Painted posts shall be clean of loose scale with one or more coats of weather resistant paint applied.

All steel posts shall be set in cylindrical concrete foundations. Holes are to be 10 inches or more in diameter for line posts, and 12 inches or more in diameter for all other posts.

1. Corner and gate posts:
   - angle iron = 2.5" x 2.5" x 0.25",
   - tubular pipe = 2.5" O.D.
2. Line posts (1.3 lbs per foot) shall be studded or punched "T", "U", or "Y" shaped with anchor plates.
3. Brace posts:
   - angle iron = 2" x 2" x 0.25",
   - tubular pipe = 1.63" O.D.
4. Steel posts for swing gate assemblies shall be of the following:

Double Swing Gates	O.D. Pipe	Weight Per Linear Ft
0 - 12 ft.	2.5"	3.1 lbs
12 - 24 ft.	4.0"	6.2 lbs
24 - 38 ft.	6.6"	18.9 lbs
38 - 46 ft.	8.6"	24.7 lbs
46 - 60 ft.	10.7"	31.2 lbs

ELECTRIC FENCE

When using electricity to divide areas, polywire or steel wire is acceptable. The number of strands needed may vary depending on the intended use of the fence. At least one wire shall be charged by an energizing unit.

Energizers - should have the following features:

1. Low Impedance.
2. Safety paced fuse to prevent over pulsing.
3. Solid state circuitry with a 5,000 to 6,000 volt output.
4. Flashing indicator light to show unit is pulsing.
5. Built in lightening arrestor.

Insultube - shall be of acceptable thickness to withstand long term exposure to ultra violet light.

Safety - is a concern when constructing electric fences. The following are guidelines of safety to adhere to:

1. Do not allow guide or line wires to contact any power lines.

2. Do not erect wires or ground wires near overhead powerlines, telephone wires, or radio antennas. It is illegal to cause interference.

3. Install energizers inside a building when possible. Energizers need not be attached to a power pole. All power supply lines should comply with local electrical codes.

4. All energizers must be connected to a separate grounding rod. Never attach energizer to any other grounding device. Fence charger ground rods need to be at least 6 feet away from any other grounding rod.

5. Only one energizer should be installed onto a fence line.

6. Where there is public access to the fence, warning signs should be placed not further than 300 feet apart.

7. Do not install or repair any part of an electric fence with the energizer switched on.

8. When testing an electric fence with a voltmeter, wear rubber gloves to minimize any shock. Wear nonmetallic hats and shoes.

9. When testing an electric fence by hand, place the palm of one hand on the soil and slide a blade of grass on the wire with the other hand. A trickle of current indicates that the energizer is working.

10. Never grasp the electrified wire with your hand. Test by using the back of your fingers. In the event of a shock, the reflex will pull fingers away.

11. In areas with dry grass, reduce the output of the energizer to minimize risk of fire.

12. Keep all metallic farm implements away from fence line. Do not tether animals with chains near any electric fences.

13. Warn all children that electric fencing is being used and let neighbors know where and how to shut off the current.

14. Do not attempt to repair or modify an energizer. Return the unit to an authorized dealer for service.

15. Do not install or repair electric fence during a thunderstorm.

16. Install lightening arrestors and chokes to protect fence.

Grounding

1. Non-electrical fences should be grounded at least every 1,000 feet, closer depending on the soil drainage class. Ground rods should be driven not less than 3 feet into the ground and be galvanized steel .75" in diameter or larger.

2. Electric fences should have ground rods placed near the energizing unit that meet or exceed the manufacturer's recommendations. The minimum acceptable ground rod depth is 6 feet, (see Attachment 3).

Lightening Protection - a lightening choke or an arrestor shall be placed between the energizing unit and the fence system to lessen the impact of natural energy surges.

BRACE ASSEMBLIES

A brace is a device, as in a supporting beam, that steadies or holds something together, (see Attachment 4).

Wooden

Braces are needed for 3 or more strands of high tensile fence as follows:

1. Single span assemblies shall be used for 165 feet (10 rods) or less of fence construction. This is recommended for straight runs on flat terrain (see Attachment 4).

2. Double span assemblies shall be used for fences 165-660 feet (10-40 rods) in length (see Attachment 4).

3. Combination single and double brace spans shall be used on rolling land with a lot of curvature. Braces should be placed every 330 feet (20 rods). Do not construct brace assemblies at the point of curve (see Attachment 4).

Metal

Bracing assemblies for chain link fence shall follow the manufacturer's recommendations. Top rails and tension bars shall be of standard lengths. Fence shall be installed on the outside of the metal posts and framing.

BEND ASSEMBLIES

When constructing wire fence along a curve or contour, post spacing is determined by the degree of bend. Curvature is measured by placing 3 stakes, spaced 14 feet apart along the fence line. A string is then stretched between stake 1 and stake 3. The measurement taken is from stake 2 to the string. Spacing of posts are determined as follows:

CURVATURE	POST SPACING
0 - 4 inches	14 feet
4 - 7 inches	12 feet
7 - 9 inches	10 feet
9 - 15 inches	8 feet
15 - or more inches	6 feet

Posts are to be placed equidistant from each other.

TENSION

1. For exterior wire fences, the tension should be maintained per manufacturers specification. At least one in-line strainer shall be on each strand with a spring tension indicator for monitoring purposes.

2. For interior wire fences, tension should be adequate to maintain the desired height and prevent wire from sagging between posts.

SPACING

Height of constructed fence fabric is determined by the species intended to control. The minimum accepted heights for exterior fences are as follows:

SPECIES	MINIMUM HEIGHT
Deer	94 inches
Horses	48 inches
People	48 inches
Cattle	46 inches
Sheep	36 inches
Swine	32 inches

1. When using wire for exterior fences, the spacings in Table #1 and Table #2 are given as a guideline. Adjustments to the number of wires and spacing may be made according to the manufacturer's recommendation (see Table #1 and Table #2).

2. The following guidelines are provided for the minimum number of wires on interior electric fences.

SPECIES	MINIMUM NO. OF WIRES
Cattle	1
Cattle w/ calves	2
Horses	2
Sheep	2
Swine	2
Cattle (hard to control)	3

Wire spacing for interior electric fences are given in Table #3.

Post Spacing - is determined by several factors such as number of strands, type of wire, soil type, terrain, and animals to be fenced. Board and barbed wire fences shall not exceed 16 1/2 feet (1 rod) between posts. The following is a guideline for high tensile fence post spacing. Batten or stay spacing is specified. If no battens are used, spacing will be that of rolling terrain.

Number Wires	0 - 8% Flat	9 - 25% Steep	various Rolling
1 - 4 (battens @ 50')	150'	100'	50'
5 - 8 (battens @ 30')	100'	60'	30'
9 or more (battens @ 20')	60'	30'	20'

OPERATION AND MAINTENANCE

Regular inspection of fences shall be part of an ongoing management program. Inspection of fences after storm events is needed to facilitate the function of the intended use of the fence.

Check all fence systems for proper functionality and maintain tension to design specifications. Where electric fences are used, periodically check output of charger with a voltmeter.

Annual clearing of weeds and brush under and near the fence systems will prolong life expectancy. Maintenance and repairs shall be performed in a timely manner to maintain the desired control.

Clearing of weeds and brush under electric fence systems is critical to maintain proper electrification.

SUPPORTING DOCUMENTATION

Record and maintain the following data for fencing and will be included in the case file:

1. Field location in feet
2. Conservation plan map
3. NRCS-CPA-6
4. Purpose of the practice:
   - species managed
   - type of fence constructed
   - date of construction
   - conservation plan.
   - NRCS-CPA-6
   - sign and check notes and include a statement that the practice meets or exceeds plans and specifications

REFERENCES

1. Fences, Missoula Technology and Development Center, 1988.

2. Terminology for Grazing lands and Grazing Animals, ISBN 0-936015-31-4, 1991.

3. Stream Bank Fencing, Penn State Extension Circular 397, 1992.

4. High Tensile Wire Fencing, NRAES, 1987.

TABLE #1 - EXTERIOR NON-ELECTRIC SMOOTH WIRE FENCE SPACING

TYPE	STRAND	WIRE SPACING FROM THE BOTTOM IN INCHES	HEIGHT
Cattle (feed lot)	10	10 - 4 - 4 - 4 - 5 - 5 - 5 - 5 - 5 - 5	52"
Horses	10	6 - 4 - 4 - 4 - 5 - 5 - 5 - 5 - 5 - 5	48"
Cattle (+ calves)	8	4 - 5 - 5 - 5 - 6 - 6 - 7 - 8	46"
Cattle	6	14 - 5 - 6 - 6 - 7 - 8	46"
Sheep	6	5 - 5 - 5 - 6 - 8 - 8	36"
Swine	6	4 - 5 - 5 - 6 - 8 - 8	36"
Flood Plains	3	18 - 12 - 12	42"

TABLE #2 - EXTERIOR ELECTRIC SMOOTH WIRE FENCE SPACING

TYPE	STRAND	WIRE SPACING FROM THE BOTTOM IN INCHES	HEIGHT
Cattle (feed lot)	7	10 - 6 - 6 - 6 - 8 - 8 - 8	52"
Horses	6	10 - 8 - 8 - 8 - 8 - 6	48"
Cattle (+ calves)	5	10 - 8 - 8 - 10 - 10	46"
Cattle	4	10 - 12 - 12 - 12	46"
Sheep	5	6 - 6 - 8 - 8 - 8	36"
Swine	5	6 - 6 - 8 - 8 - 8	36"
Flood Plains	3	18 - 12 - 12	42"

TABLE #3 INTERIOR ELECTRIC FENCE SPACING

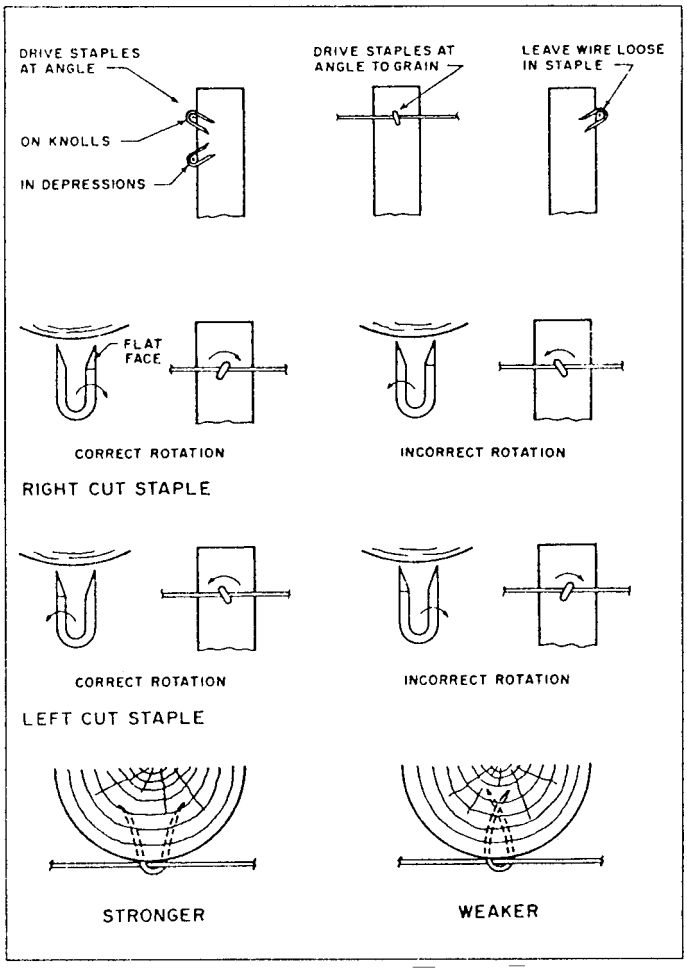
NUMBER OF WIRES	WIRE SPACING FROM THE BOTTOM IN INCHES	HEIGHT
1	30(+)	30"
2	16(-) - 16(+)	32"
3	12(-) - 10(+) - 14(+)	36"
4	12(-) - 10(+) - 8(-) - 10(+)	40"
5	10(-) - 8(-) - 8(+) - 8(-) - 10(+)	44"

Suggested Charging Sequence:

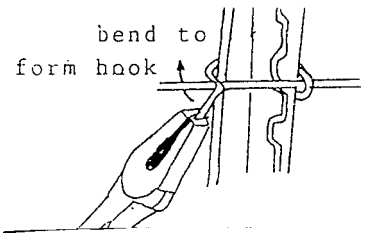
(+) = charged wire
(-) = ground wire

ATTACHMENT 1 - STAPLES AND CLIPS

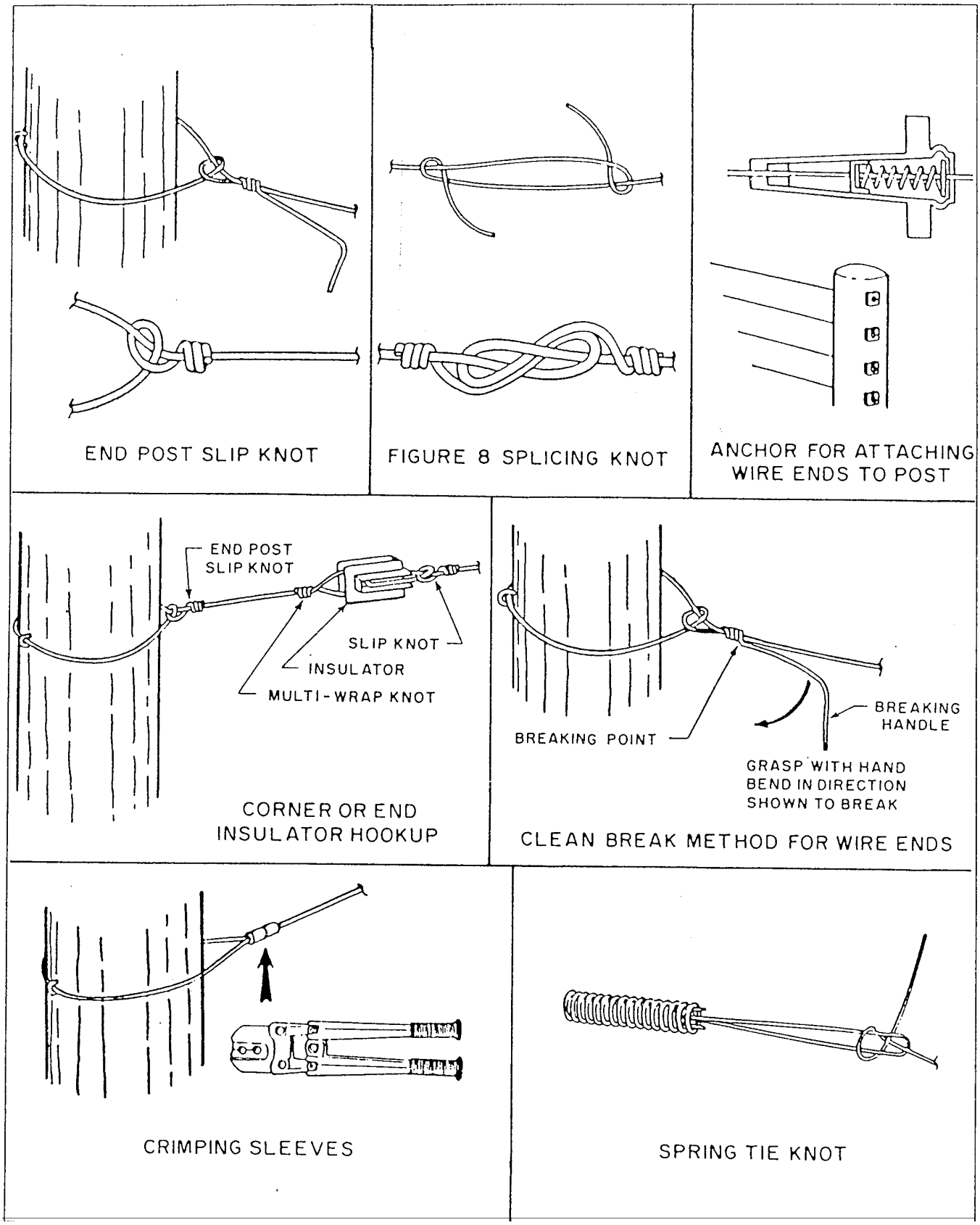
Staples for Wooden Posts



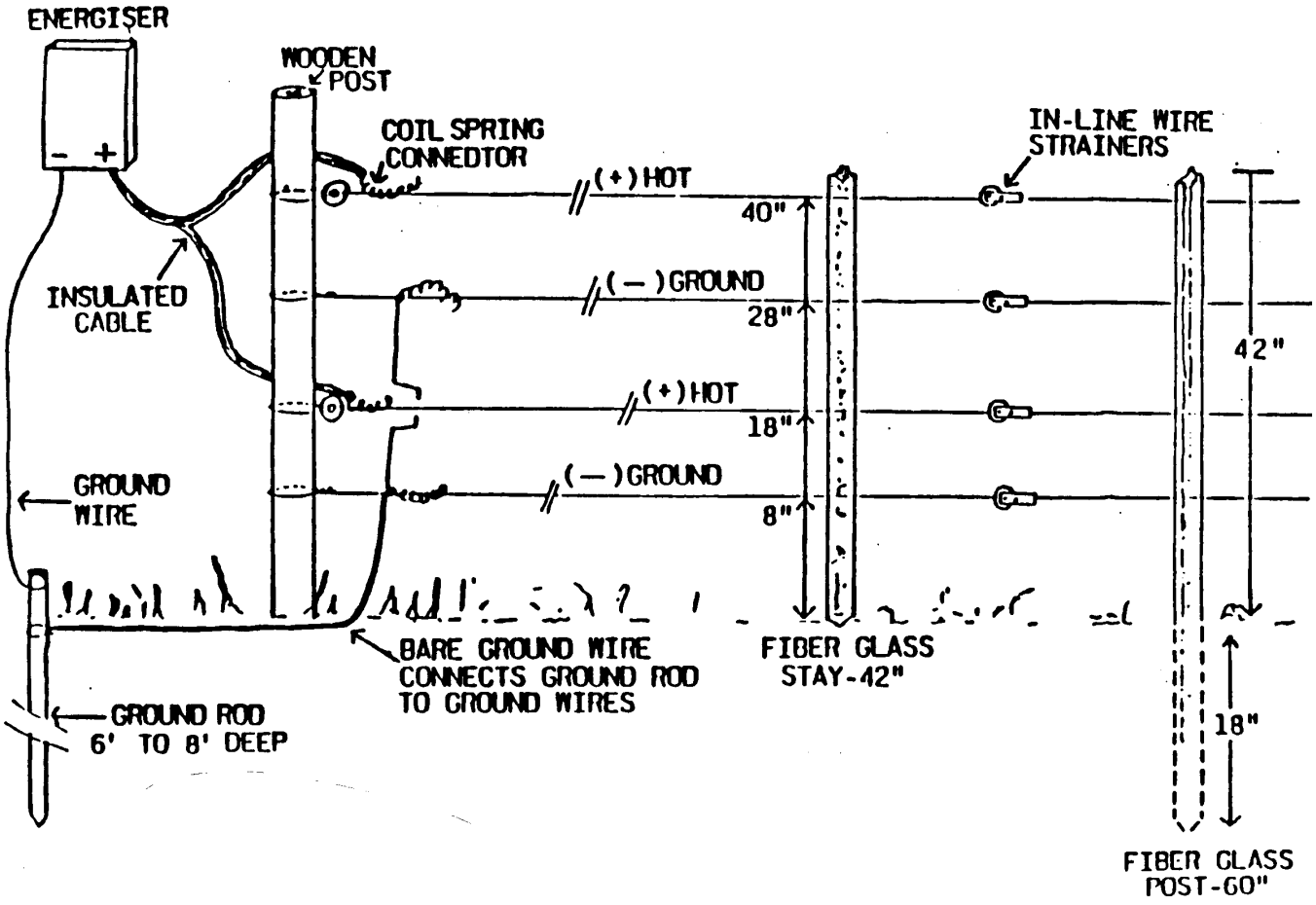
Clips for Steel and Notched Fiberglass/Plastic Posts



ATTACHMENT 2 - SPLICES AND KNOTS

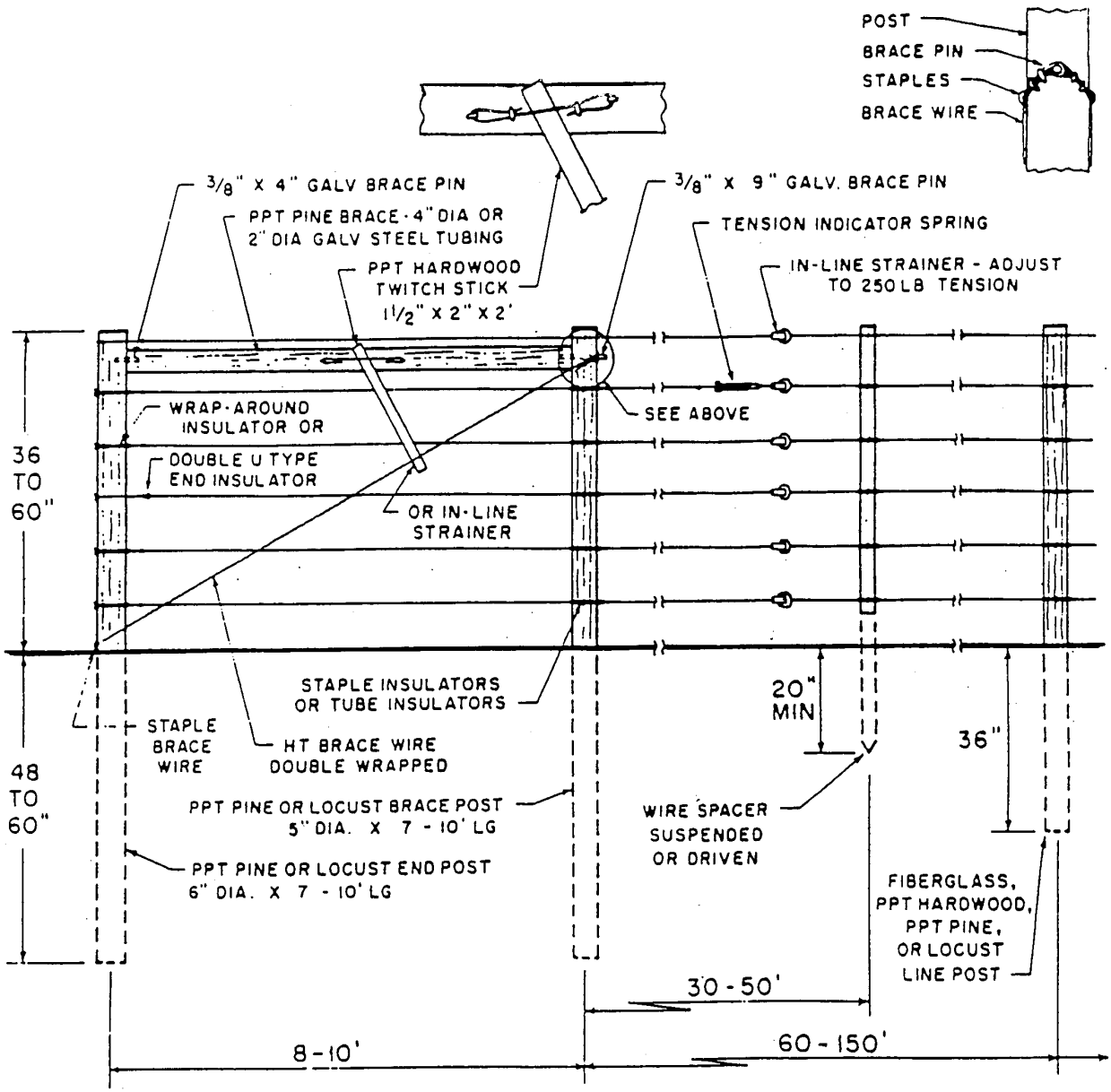


ATTACHMENT 3 - TYPICAL 4 WIRE HOT/GROUND SYSTEM[1/]



1/ This drawing does not indicate how to construct the corner brace. It will be constructed the same as for regular fences except steel pipe will not be used.

ATTACHMENT 4 - BRACE ASSEMBLIES



Wooden